

A Discussion of the Guiding Principles and Procedures

Governing Project Cost Estimating

Importance of Quality Cost Estimates

The reliability of project cost estimates at every stage in the project development process is necessary for responsible fiscal management. Unreliable cost estimates result in severe problems in programming, budgeting, and planning. This, in turn, affects Engineering Services relations with the other divisions within Public Works & Utilities, other agencies, and the public, and ultimately results in loss of credibility.

Prepare Reasonable Cost Estimates

Project cost estimating is not an exact science; however, estimators are expected to prepare reasonable project cost estimates that represent the cost to complete the project. These costs include those required not only for the contractor to construct the project but, also includes the costs for the purchase of right of way, mitigation of environmental issues and any other costs that will be incurred to complete the project.

Project alternatives and their associated cost estimates must be thoroughly compiled by diligently using all of the available data, modifying that data with good judgment and using past cost estimating experience so that the cost estimates can be used with confidence. Coordination between the project planning cost estimates, the project design cost estimates, and the specifications and policies that will be in place during the construction of the project is required.

Cost Estimates are Not Static

Cost estimates, in a sense, are never completed. They are not static, but have to be reviewed continually to keep them current. The Project Manager (PM) is responsible for keeping the project cost estimate up-to-date throughout the project development process, reviewing all project cost estimates and ensuring that the current project cost estimates are entered into the Project Management data base and a hard copy is in the project file.

Cooperative Projects

For those projects with multiple sources of funding, segregated cost estimates are needed. To avoid confusion, as soon as the participatory rules for the project are determined, use segregated cost estimates that show the funding responsibilities of the various partners on the project. Define the various participants funding responsibilities as early as possible in the project development process. Communication among the various partners is very necessary to insure reliable project cost estimates.

Helpful Hints:

- Do not create a project cost estimate in a vacuum. Consult others either internal or external to Engineering Services, as appropriate, in the preparation of the cost estimate. Gather as much information as possible for the project and its various alternatives. It is better to have too much information than not enough.
- Project cost estimates should never be artificially reduced to stay within the funding limits.

Total Project Cost Estimate Parts

A project estimate should be made up of five parts as follows:

Preliminary Engineering	(PE)
Utility Relocations	(UTIL)
Right-of-Way Acquisition	(ROW)
Construction	(Const)
CE	(CE)
Total Project Cost	(Proj. Est.)

The timing of the estimate affects the amount of detail included in the estimate. For this discussion we will look at three general levels of estimating.

Categories of Estimating Levels

- High Level Estimates – Generally those estimates performed before any design work is performed – Generally called programming or planning level estimates.
- Mid Level Estimates – Generally those estimates performed during design work is performed
- Low Level Estimates – Generally those estimates performed at the P, S, & E time and during the construction.

Preliminary Engineering (PE)

Assumptions – PE includes all activities prior to bid letting. PE would include surveys, conceptual design, preliminary design, final design, functional design, project management, environmental, etc. Basically if you perform some sort of work on a project between conception and the P, S, & E submittal it should be accounted for as Preliminary Engineering.

General Rules of Thumb for High Level Estimates

- PE = 0.5% of Construction Estimate for Resurfacing (In-House Design)
- PE = 4.4% of Construction Estimate for New Construction (In-House Design)
- PE = 8.0% of Construction Estimate for New Construction (Consultant Design)

General Rules of Thumb for Mid Level Estimates

- PE = 0.5% of Const Est. for Resurfacing (In-House Design), unless you know something different
- PE = 4.4% of Const Est. for New Construction (In-House Design), unless you know something different
- PE = Consultant Contract Amount Plus 5 to 7% of the Consultant Contract, unless you know something different.

General Rules of Thumb for Low Level Estimates

- PE = Actual Costs Accumulated plus an additional amount for any anticipated remaining work yet to be completed.

Utility Relocations (UTIL)

Assumptions – UTIL includes costs for relocation of private utilities that must be paid for by the project. **Question: If an easement is needed to replace the existing private utility easement, then those costs should be included in the ROW costs or in the UTIL costs?**

General Rules of Thumb for High Level Estimates

- UTIL = 0.2% of Construction Estimate for Resurfacing
- UTIL = 3.0% of Construction Estimate for New Construction
- Adjust for any known special items such as pipelines; substations; large overhead lines; fiber optics; switch gears; etc.

General Rules of Thumb for Mid Level Estimates

- Actual cost estimates from the utility company that is doing the relocation.

General Rules of Thumb for Low Level Estimates

- Actual Costs Accumulated plus an additional amount for any anticipated remaining work yet to be completed including changes during construction.

Right of Way Acquisition (ROW)

Assumptions – ROW includes any and all costs associate with the acquisition of the right-of-way, permanent, and/or temporary easements need to complete the project. This would include appraisal, negotiation services, legal services for condemnations plus cost for real property.

General Rules of Thumb for High Level Estimates

- ROW Acres x Unit Price/Acre
- ROW Square Feet x Unit Price / Sq. Ft.
 - Industrial = \$0.50 to \$1.00 per Sq. Ft.
 - Residential = \$2.00 to \$3.00 per Sq. Ft.
 - Commercial = \$10.00 to \$25.00 per Sq. Ft.
- Adjust for any known Special ROW Items such as Relocations; Access changes; Acquisition of Uneconomical Remnants; Costs to Cure, Removals

General Rules of Thumb for Mid Level Estimates

- Use the appraised values

General Rules of Thumb for Low Level Estimates

- Actual Costs Accumulated costs plus an additional amount for any remaining tracts yet to be acquired.

Construction Engineering (CE)

Assumptions – CE includes all activities after the bid letting. CE would include construction inspection, surveys, revisions to design, project management, laboratory & testing. Basically if you perform some sort of work on a project after the bid letting it should be accounted for as Construction Engineering.

General Rules of Thumb for High Level Estimates

- CE = 6 to 9% of Construction Estimate for Resurfacing
- CE = 8 to 10% of Construction Estimate for New Construction

General Rules of Thumb for Mid Level Estimates

- CE = 6 to 9% of Construction Estimate for Resurfacing
- CE = 8 to 10% of Construction Estimate for New Construction

General Rules of Thumb for Low Level Estimates

- Actual Costs Accumulated plus an additional amount for any anticipated remaining work yet to be completed.

Construction (Const)

Assumptions – Const includes those costs need to construct the project and make it functional.

General Rules of Thumb for High Level Estimates

- Use a cost per linear unit (i.e. \$3.2 million per mile; \$5 per linear foot)
- Use a cost per area unit (i.e. \$75 per square foot; \$5 per square yard)
- Compare to similar size and type projects of recent vintage.

General Rules of Thumb for Mid Level Estimates

- Use known quantities with APPIA estimator unit bid prices
- Adjust for items unknown at the time of the estimate

General Rules of Thumb for Low Level Estimates

- Use final quantities with APPIA estimator unit bid prices.

Group #1	General
Group #2	Grading
Group #3	Paving
Group #4	Storm Drainage
Group #5	Traffic Signal Only Items
Group #6	Joint Electrical Traffic Signal / Street Lighting
Group #7	Street Light Only
Group #8	Pavement Marking & Signing
Group #9	Miscellaneous
Group #10	Erosion Control
Group #11	Water Main Replacement
Group #12	New Water Mains
Group #13	Waste Water
Group #14 - #99	Other Items Need Separation - Landscaping

Helpful Hints:

Consider the factors that affect construction costs when reviewing the appropriateness of the estimate.

Traffic Conditions

Prices should be adjusted to reflect difficulties, dangers and expenses caused by traffic conditions. Contractors are inclined to raise their prices on projects to be constructed with work sites exposed to considerable traffic.

Restrictive Work Hours / Method of Work

The prices for work that is limited to short shifts, or required to be completed in long shifts, or limited to nighttime operations should be increased to reflect the cost of premium wages required for such work and for the general inefficiencies and decreased productivity that may result. Night work for plant operations can especially be expensive when small quantities are involved. Plants usually do not operate at night and may require special production runs at much higher than normal operating costs

Separate Operations

Separate operations will usually increase item costs, especially if the order of work or the work unit is to be constructed in scattered locations throughout the project (each requiring move-in and move-out costs). If this is the case, unit prices should be based on the smaller unit sizes and should not be based upon the entire quantity for the total project.

Quantities of Work

Small quantities of work usually always have higher unit cost than identical work in larger quantities. This is because move-in, overhead, and other such costs must be distributed over a smaller base. Production rates are also less efficient and are usually slower for small quantities, which also tend to increase unit prices.

Handwork and Inefficient Operations

Handwork and small or inefficient operations (even though equipment may be used) will have higher unit costs than work that is able to be mass produced or constructed by using techniques that result in higher production rates.

Geographic Location & Accessibility

Geographically remote locations usually result in higher bid prices. It is also important to take into account where the sources of supply are and the distance to the project from which materials must be delivered. Work requiring long out of direction movements by construction personnel and equipment can be especially expensive. Material hauling that must be accomplished by entering and exiting only from certain directions, material hauling uphill rather than downhill, work on the top of slopes or retaining walls, etc. is always more expensive.

Construction Season

The time of the year that the project is advertised and constructed affects the unit cost for items of work. Contractors usually are more readily available for work early in the spring. Later in the spring or during the summer many contractors have on-going projects that keep them busy, therefore, they tend to bid higher or not at all. Consideration should also be given when a project is to be awarded near the end of summer or the construction season. It is important to know if the work can be accomplished before winter weather causes the project to be shut down. If the job

cannot be finished before the end of the construction season and the project needs to be suspended, contractors will increase their bid prices to cover their overhead during the winter and repair any damage that may occur. Even if contractors reasonably expect to finish before the winter, they may protect themselves to allow for an early winter. This can especially be true if construction involves work on items that may be affected by winter weather.

Material Shortages

Material shortages will have a major affect on prices since prices are directly affected by supply and demand. Where a shortage is especially acute, a change in design might be considered rather than increasing prices.

Contingencies

Assumptions –Contingency factors for cost estimates vary depending on the cost estimate type. Contingencies are intended to compensate for the use of limited information. The percentage goes down as the project becomes more defined and thus less unknown. Contingencies are not intended to take the place of incomplete design work. The expectation is that cost estimate prepared at any stage of a project has a 90% confidence factor of not being exceeded by the cost at completion.

General Rules of Thumb for High Level Estimates

- Should have 10-15% contingency at conception

General Rules of Thumb for Mid Level Estimates

- Should have 7-12% contingency during design

General Rules of Thumb for Low Level Estimates

- Should have 5% contingency at bid letting

Cash Flow

After the cost estimate is prepared, it should be expressed in cash flow. This can be done by assigning an inflation rate per year. Make certain that the selected month/quarter/year-of-expenditure reflects a realistic scenario, taking into account project planning and development durations, as well as construction. Potential schedule slippages can also be accounted for in a project contingency. Clearly specify how inflation is considered in the estimate and clearly state that the estimate is expressed in year-of-expenditure dollars. Reporting the costs in year-of-expenditure dollars will greatly reduce the media and public perception of cost growth.

Other Sources for Review

<http://www.fhwa.dot.gov/programadmin/mega/cefina1.htm>

http://www.dot.ca.gov/hq/oppd/pdpm/apdx_h1m/apdx_aa/apdx_aa.htm

<http://www.tlma.co.riverside.ca.us/trans/estimates.html>

<http://www.mainroads.qld.gov.au/MRWEB/Prod/Content.nsf/0/02c5ce00d16de3764a256e4000101970?OpenDocument>

Attachment A – Cost Estimate:

High to Mid Level - PROJECT COST ESTIMATE

ITEM	UNIT	QTY	UNIT PRICE	AMOUNT
1. SITE CLEARING AND GRUBBING	L. Sum	1	\$	\$
2. ROADWAY EXCAVATION	Cu. Yd.		\$	\$
3. DRAINAGE EXCAVATION	Cu. Yd.		\$	\$
4. BORROW	Cu. Yd.		\$	\$
5. AGGREGATE BASE	Cu. Yd.		\$	\$
6. ASPHALTIC CONCRETE (AC)	Ton		\$	\$
7. PIPE CULVERT	Ln. Ft.		\$	\$
8. GUARDRAIL	Ln. Ft.		\$	\$
9. SIGNING & PAVEMENT MARKING	Sq. Ft.		\$	\$
10. SIDEWALK	Sq. Ft.		\$	\$
11. CURB & GUTTER	Ln. Ft.		\$	\$
12.			\$	\$
13.			\$	\$
14.			\$	\$
15.			\$	\$
16.			\$	\$
17.			\$	\$
18.			\$	\$
19.			\$	\$
20.	SUBTOTAL ROADWAY			\$
21. CONSTRUCTION SURVEY (1-3%)	L.Sum	1	\$	\$
22. FURNISH WATER SUPPLY, DUST PALLIATIVE (1-2%)	L.Sum	1	\$	\$
23. TRAFFIC CONTROL (8%)	L.Sum	1	\$	\$
24. MOBILIZATION (10%)	L.Sum	1	\$	\$
25. QUALITY CONTROL (1-2%)	L.Sum	1	\$	\$
26. CONTINGENCIES (___%)	L.Sum	1	\$	\$
27. CONST. ENGINEERING (15%)	L.Sum	1	\$	\$
28. CHANGE ORDERS (5%)	L.Sum	1	\$	\$
29.	CONSTRUCTION TOTAL			\$
30. INFLATION FACTOR	(___%/Yr.) x Const. Total = Future Year Cost			\$

Attachment B – Checklist: How have the following factors been considered during the preparation of the cost estimate? Identify critical issues and risks.

Cost Item	Estimated Cost	Critical Issues and Risks
Preliminary Engineering		
Right-of-Way		
Construction Cost		
Contracting Technique		
Surety		
Economic Impact		
Competition		
Wrap up Insurance		
Specialized Technology		
Material Availability		
Construction Time		
Construction Incentives		
Protection of the Traveling Public		
Design Progression		
Construction Administration		
Construction Contingencies		
Environmental Document Preparation		
Environmental Mitigations/Enhancements		
Utility Adjustments		
Railroad and Transit Adjustments		
Public Outreach		
Management Reserve		
Cost Escalation		
ITS		

Aesthetic Treatments/CSD

Other cost items should be added depending on the project's characteristics.